YEARBOOK

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OF

PACIFIC COAST GEOGRAPHERS

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ASSOCIATION OF PACIFIC COAST GEOGRAPHERS

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Association Affairs

The Association of Pacific Coast Geographers held its third annual meeting June 23 to 25, 1937, in conjunction with the one hundredth national meeting of the American Association for the Advancement of Science in Denver, Colorado. Twenty-four papers were presented during the Wednesday and Thursday morning sessions in the auditorium of the Barnes Commercial School; Dr. Howard H. Martin presiding. The principal addresses were delivered at two luncheon meetings in the Venetian Room, Shirley-Savoy Hotel. On Wednesday Dr. E. Earle Lackey, of the University of Nebraska and President of the National Council of Geography Teachers, discussed "Crop and Rainfall Expectancy in Nebraska," and on Thursday Dr. Martin, chairman of the Geography Department, University of Washington, and retiring president of the organization, gave an illustrated lecture on "Colonization and Exploitation in Northern Japan." On Thursday afternoon the society joined in the general symposium on "The Scientific Aspects of the Control of Drifting Soils." The Wednesday afternoon field trip around Denver was under the guidance of Dr. Margaret F. Boos, University of Denver. Under the leadership of Professor Harold A. Hoffmeister of the University of Colorado, who also served as chairman of the committee on local arrangements for the meetings, the group made a field investigation of the mining industries and the sequence of occupancy in the Idaho Springs-Central City area on Friday.

Officers of the Association for the coming year are: President, George M. McBride, University of California at Los Angeles; Vice-President, John B. Leighly, University of California; Secretary-Treasurer, Hallock F. Raup, University of California at Los Angeles; Yearbook Editor, Otis W. Freeman, Eastern Washington College of Education, Cheney.

The papers and abstracts included in this third volume of the "Yearbook of the Association of Pacific Coast Geographers" were among those presented at the Denver meetings.

W. B. MERRIAM, Acting Sec'y.

The 1938 Meeting

The 1938 meeting of the Association of Pacific Coast Geographers will be held in San Diego, California, in connection with the meetings of the Pacific Division of the A. A. A. S. on two or three days during the week of June 20 to June 25. Several institutions and organizations in the San Diego region will cooperate with the A. A. A. S. meeting.

Secretary Raup will notify the members of the A. P. C. G. of the exact dates.

YEARBOOK OF THE ASSOCIATION OF PACIFIC COAST GEOGRAPHERS

Vol 3 1937

The Geographic Factor and Its Influence on Utah Administrative Units

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When the Mormon Pioneers settled in the Great Basin in 1847, they claimed a vast expanse of territory, extending to the Sierra Nevada Mountains on the west, to San Diego on the south, to Oregon on the north, and to the summit of the Rocky Mountains on the east.

Their hopes for a sea port were denied when in September, 1850, the United States Congress passed a bill providing for the organization of the Territory of Utah. The boundaries were defined as follows: "Bounded on the west by the State of California, on the north by the Territory of Oregon, and on the east by the summit of the Rocky Mountains, and on the south by the 37th parallel of north latitude. (Bancroft's History of Utah). Although a large portion of their claim had been taken on the south, the pioneers were granted a great region, including what is now Utah, and most of Colorado and Wyoming.

Settlement of the outlying regions of the new Territory began almost immediately. Not only were the pioneers eager to validate their claim to the land by habitation, but hundreds of immigrants from the East and even from Europe were arriving in Utah every year, and needed land on which to make a living. Consequently, a steady flow of settlers out of Salt Lake City toward the north and south was seen in the following years.

This expansion continued until settlements were found in many places hundreds of miles from Salt Lake and the necessity of subdividing this vast region for governmental purposes was recognized, even before the official establishment of Utah Territory by Congress. In the winter of 1849-50 the legislature of the unofficial State of Deseret created six counties: Great Salt Lake, Weber, Utah, Tuilla, San Pete, and Juab (Fig. 1). Their method of determining the boundaries of these first counties was simply that of conforming to the natural or physiographic divisions which they found and recognized as logical units for government administration. The following are sample definitions of the first six counties as established by the Deseret Legislature early in 1850. (From *Ordinances of the State of Deseret*, 1850.)

"An ordinance providing for the location of counties and precincts therein named, etc."

Sec. 1. Be it ordained by the General Assembly of the State of Deseret, that all

that portion of country known as Weber Valley, and extending as far south as Stony Creek, and west to Great Salt Lake shall be called Weber County.

Sec. 4. All that portion of country known as the Valley of the Great Salt Lake, and lying south of Stony Creek, shall be called Great Salt Lake County.

Sec. 11. All that portion of country called Utah Valley, shall be called Utah County; the county seat of which shall be located at Provo City.

Sec. 13. San Pete Valley shall be a county, including the boundaries of said valley, and called San Pete County.

Sec. 14. Tuilla Valley shall be a county, called Tuilla County, having one precinct, until otherwise ordered by the county court.

Sec. 17. Whenever a county is mentioned as including a valley, the boundaries of the same shall extend to the natural boundaries of said valley—the summit of the surrounding mountains, on the highest dividing range between said valleys.

Approved January 31, 1850.

For clarification it is necessary to mention again that these first six counties were created when little was known of this region and before the official designation of the Utah Territory. Until 1849 the settlers had no political or legal government. They lived under ecclesiastical laws and followed the leadership of Brigham Young and his associates. After 1849 the need for legal action prompted organization of the "deseret legislature" with both a judicial and executive department, courts were also established in the respective counties. When the belated news of the official designation of the Territory of Utah was received early in 1851, the Mormons proceeded immediately to reorganize. The first session of the new Territorial Legislature divided the entire Territory into twelve counties. A striking change in the boundaries of the original six counties was seen at that time (Fig. 2). They were extended far beyond the valleys of the original limits and were made to embrace great belts or land ranging from 50 150 miles wide and hundreds of miles long.

It is an astounding fact that in less than two years after the official designation of the Territory of Utah, its entire area had been divided into counties, despite the fact that it covered about 250,000 square miles and very little was known of the country beyond the region immediately surrounding Salt Lake City. The motive for such hurried action in dividing this immense tract of land into counties even before it was entirely explored is seen in the fact that the early settlers were eager to lay firm hold upon the Territory, thus resisting encroachment by other groups. This gaining of political control was probably considered by the pioneers as a gesture which would be recognized at the National Capitol. It was a notice of their intention to colonize the entire Territory, although for practical purposes the small valleys were the most logical county units.

FIGURE 2

Some Utah counties in 1852 were nearly 800 miles long. Just why these counties were defined in such a manner is explained by the fact that only one means of determining boundaries was available: parallels and meridians. These imaginary lines which encircle the earth could be located on a map in the absence of information pertaining to physiographic features. The Territory's southern boundary was fixed by Congress at the 37th parallel of latitude and the northern boundary at the 52nd parallel. These specifications provided a relatively easy method of marking off sections on a map. The authorities defining the new counties, merely had to draw lines across a map of the Territory parallel to its north and south boundaries.

Every year following the establishment of Utah Territory witnessed the arrival of thousands of emigrants and the new counties received settlers who migrated hundreds of miles in every direction from Salt Lake City.

The necessity for breaking up these enormous units arose early as towns sprang up all over the Territory. Local government as well as representation in the legislature was necessary. Lack of communicative facilities and the primitive methods of travel necessitated short distances between county seats and outlying towns, thus rendering the originally enormous counties unsuitable for governing purposes.

In the years that followed a number of counties were added, and as was the case with the first twelve counties designated in 1852, the new boundaries were again determined by existing latitudinal and longitudinal lines. The boundaries of the entire Territory, however, remained intact until the year 1861, when by congressional acts the Territory of Nevada was created to include a large area from 116° west longitude to California. In the same year a large strip east of longitude 109°4′ was designated as the Territory of Colorado and in 1862 another degree of longitude was given to Nevada on the west.

In 1868 however the last reduction of the Territory of Utah was made; all of the Green River except a small strip of land north of the Uintah Mountains being taken away, and added to the Territory of Wyoming.

The settlement of Utah Territory continued at a rapid pace and rearrangement of counties was carried on to meet the needs for county government and legislative representation. However, a striking change in method of establishing boundaries came about in the early 1860's. Instead of arbitrarily following the artificial lines of latitude and longitude, legislators took into consideration the natural geographic features of the Territory, such as mountain ranges, rivers, plateaus, lakes, etc.

It is interesting to note that the parallels of latitude which formed the boundaries of early counties have remained largely intact. The long belts of land which made up the first twelve counties can easily be distinguished today, although they have been intersected at various points to form new counties. If one were to blot out boundary lines following mountains, plateaus, and rivers, the couties would still appear as a series of parallel lines running east and west, especially in the southern portion of the state. Since the great majority of mountain ranges, plateaus, and rivers in Utah follow a north-south direction, it is evident from a map that these lines arbitrarily established more than eighty years ago, run at right angles to the State's physiographic features. The northern boundary of Beaver county cuts directly across four mountain ranges. The northern boundary of Garfield county runs at right angles across two plateaus, a range of mountains, and a river. The southern boundaries of Emery and Grand Counties cut directly across three rivers, a series of cliffs, and a range of mountains. The east and west boundaries of Duchesne County are straight meridian lines which divide the natural Uintah Basin into three arbitrary units.

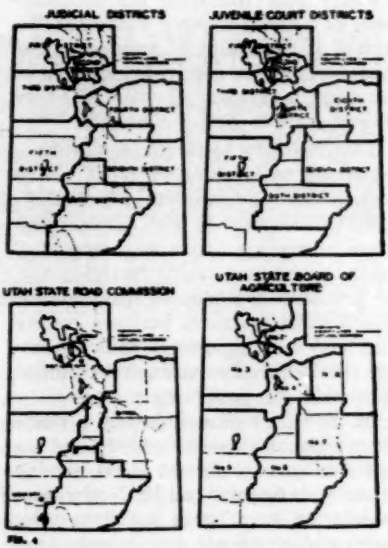
The manner in which the first six counties of Utah were originally created indicated that natural boundaries were recognized even then. It is probable that had the entire Utah Territory been as familiar to the pioneers as the region surrounding Salt Lake, the boundaries would have yielded to natural geographic features in every case. With the increase of information regarding the geography of the region these straight latitudinal lines should have disappeared.

As the State exists today, approximately 55 per cent of the county boundaries are straight, arbitrary lines, while 45 per cent conform to natural barriers, such as mountain ranges, rivers, plateaus, etc. From 1850 to 1917 ninety-two major changes are recorded in the boundary histories of existing Utah counties.

The present arrangement of the

counties in the state of Utah offers a rather interesting contrast to the configuration of administrative units adopted by other more recently established agencies whether private, state, and federal (Fig. 3 & 4).

The historical factor is important here, since it probably accounts for the far greater number of subdivisions in the case of counties than in the case of State departments. No counties have been created since 1917, and the great majority were in existence prior to 1880. On the other hand, most State agencies are of comparatively recent origin. Small counties were necessary during the years when primitive means of transportation and communication limited travel to but a few miles a day and restricted contacts with centers of government. County seats had to be placed within reach of outlying villages and rural communities. The horse-and-buggy days necessitated small counties for the administration of governmental affairs. Tradition, political inertia, vested interests, a general conservatism, and a reluctance to accept the new have maintained the twenty-nine counties even in the face of obvious need of change as evidenced by the adjustments made in governmental units

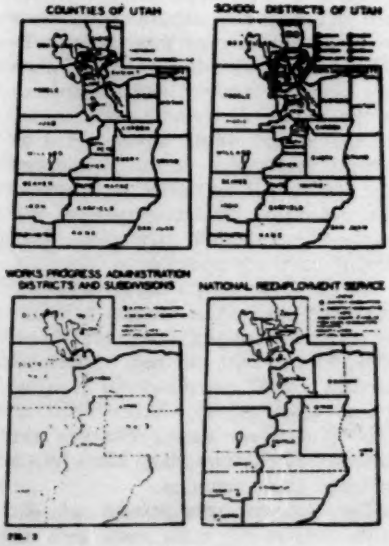


attempting to more efficiently meet the State needs.

The school district system carries earmarks of the county system of administration units established in the days when slow transportation necessitated small districts for intimate contacts and supervision, and hence its outlines follow closely that of the counties, with several counties subdivided into two or more districts, making a total of forty school districts at the present time.

In contrast to those districts are those of other state agencies which have been established in recent years. In 1935 the Utah Works Progress Administration, a subdivision of the National administration, divided Utah into three main districts with Ogden, Salt Lake City, and Provo as headquarters for Districts 1, 2, and 3, respectively. District 3 is subdivided into four smaller units with Price, Richfield, and Cedar City as subheadquarters.

The influence of roads and communication lines on the W. P. A. configuration is well illustrated in the subdivisions of District 3. The western boundary of the Richfield District runs practically parallel to U. S.


COUNTIES OF UTAH
SCHOOL DISTRICTS OF UTAH
WORKS PROGRESS ADMINISTRATION DISTRICTS AND SUBDIVISIONS
NATIONAL REEMPLOYMENT SERVICE

Highways 89 and 91. Cedar City was selected not only for its greater population and trade facilities, but because it is the only city in that section of the State which has a railroad connection. Rapid communication from offices to outlying communities is essential. Roads leading from Price to the remote regions of the southeastern part of the State make it the logical headquarters of that district.

The most important factor determining the shape and size of these districts, and one which underlies the motives just discussed, is that of natural geographic features. While physiography indirectly influences population and trade centers and roads, it has a very definite and direct effect upon the manner in which the districts are laid out. The Uintah Mountains form a natural barrier which separates the Ogden and Provo Districts. Roads over these mountains are impassable during the winter, and the futility of attempting to cross this natural barrier is obvious.

The Tushar and Pavant Mountains are recognized as the natural and logical boundary between the Richfield and Cedar City sub-districts. The few roads crossing these mountains between U. S. Highways 89 and 91 are blocked by snow part of the year, often rendering any transportation between the two great valleys impossible, while fine roads running north and south on each side of these mountains facilitate communication with the main W. P. A. office in Provo. The Wasatch plateau and the Colorado River form barriers which naturally set off the Price District from the Richfield District. Straight lines arbitrarily drawn are sufficient as boundaries across the desert wastes of Western Utah where there is practically no population.

The sub-headquarters of Price, Richfield, and Cedar City are considered temporary and subject to removal at any time. This provides a flexible set-up whereby practically all territory south of Salt Lake City can be handled from the Provo office. One of the most cogent reasons for maintaining three large districts instead of operating upon a county basis is that to maintain twenty-nine staffs of officers would entail such a cost as to defeat the purpose of this agency. Since overhead expense is one of the primary considerations, a few officers controlling large districts is more economical than maintaining a large number of smaller districts.

The same factors that have influenced the establishment of the W. P. A. system of administrative units have likewise influenced such agencies as the National Reemployment Service, Judicial Districts, Juvenile Court Districts, Utah Road Commission, Utah State Board of Agriculture, State Department of Public Welfare, Utah State Board of Health, State Senatorial Districts, Tax Commission Sub-Headquarters and many others, in fact sixty-six agencies in all were contacted in this study and all of them reported geography as one of the main guiding factors in marking off their subdivisions. Such impassable barriers as the great Colorado and Green Rivers and the many high, rugged mountain ranges, cliffs, and plateaus are not to be disregarded in setting up any sort of district where travel among the several towns is necessary. The location of these barriers consequently play a major role in the arrangement of districts. It is of utmost importance that we note how these various agencies divide the state up into its five, six, or seven major geographic divisions.

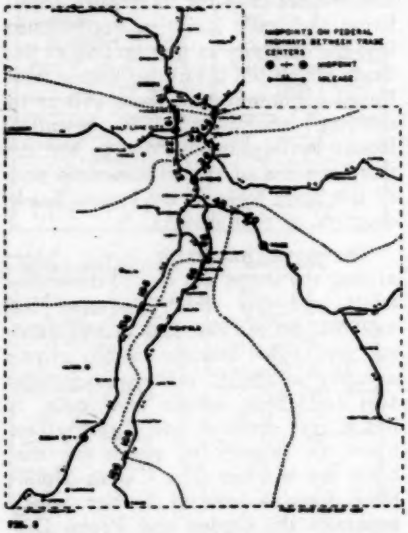
A study of the growing trade centers in the state reveals the fact that 61 per cent of all incorporated towns of the state have lost in population during the last decade and twelve entire counties have likewise recorded a loss, while the state as a whole has experienced a gain of 13 per cent. This definite shift in population has resulted in substantial growth for six or seven natural trade centers ideally located with respect to natural geographic hinterlands.

A study of mid-points on highways

between the growing trade and population centers discloses a rather close correlation of roads and trade centers with natural geographic regions thus justifying the suggestion that administrative units, whether private, state, or federal, operate at their greatest advantage when their institutional boundaries are made to conform to the natural boundaries of their respective units (Fig. 5).

Had the Morman Pioneers known more of the physical base upon which they hoped to build their great empire and its attending political and social institutions, they likely would not have arbitrarily divided the territory into a series of great linear belts for administrative purposes, but would have let natural geographic features guide them in the designation of units upon which their institutions hoped to find anchorage.

MIDPOINTS BETWEEN TRADE CENTERS



BIBLIOGRAPHY

Bancroft, Herbert Howe: "History of Utah."

Compiled Laws of Utah, 1855, 1888, 1907, 1917.

First Annual, and Special Sessions of the Legislative Assembly of the Territory of Utah, 1855.

Hansen, George H.: "A Regional Redistricting Plan for the State of Utah."

Jenson, Andrew: "L. D. S. Church Chronology."

Laws of the Territory of Utah, 1856, 1861, 1862, 1864, 1866, 1867, 1868, 1869, 1870, 1872, 1876, 1880, 1882, 1884, 1888, 1890, 1892, 1894.

Laws of Utah, 1913, 1917, 1919, 1921, 1931.

Ordinances of the State of Deseret, 1850 (Volume entitled "Constitution of the State of Deseret").

Tullidge: "History of Utah" (vol. 1 & 2).

Utah State Road Commission, 1935.

Whitney, Orson F.: "History of Utah" vol. 1, 2, & 3).

Young, Levi Edgar: "Founding of Utah."

Vegetation Aids for Recognizing Boundaries of Glacial Features

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Vegetation, though seldom mentioned or credited in final writings, has served many a field worker in his efforts to untangle the evidence of Pleistocene glacial advances. Many early publications on Pleistocene glaciology seem to have been written from the observation car platform. From this point of view, floral cover must have ranged with topographic form and position as factors used in identification of glacial deposits. These arm chair field trips left a bad taste in the mouths of younger, more energetic field workers, who, swinging to the other extremes, insisted on detailed geologic study of the entire boundaries of each deposit.

It should not be assumed that vegetation can or will replace careful field investigation of glacial deposits; nevertheless, it may be used as an aid in the recognition of and mapping of the glacial boundary. With the many areas of glacial deposits as yet untouched by field work, reconnaissance mapping seems both necessary and practical. These maps should depend upon geological work as well as visual aids. Contacts between different gla-

cial deposits should be mapped and studied at numerous points, but, often, time and finances do not permit detailed mapping. By noting the types of vegetation characteristic of the different glacial deposits, one can often retire to some distant, elevated position, and, using the vegetation as an aid, connect the units that have been intensively studied. In this way the contacts between deposits can be drawn quite accurately and quickly.

Field studies that prompted this paper were confined to the semi-arid regions in or near the eastern boundaries of the Rocky Mountains in the states of Colorado, Wyoming, Montana, and the Province of Alberta. Physical factors of the environment are remarkably similar throughout this whole region. The elevation of the respective landscapes, of course, decreases from 9,000 feet in Colorado to 4,000 feet in Alberta. With the exception of Colorado, the precipitation is near the critical amount that divides scrub and tree growth from grassland. Because of this amount of moisture, the type of vegetation depends upon the drainage, soil development, and the exposure to rain-bearing winds.

The recognition of two distinct glacial advances[1] permitted a careful study of contrasting vegetation on two out wash plains and associated moraines. The most recently deposited outwash plains (Wisconsin?) were covered with a luxuriant growth of grass. Where these plains extend beyond the mountain front the areas are relatively level or gently rolling and are covered with a thick sod. Where similar outwash is deposited in valley trains, the surfaces are usually covered with recent alluvium. Since most of the valley trains are only eight to twenty feet above the streams, they can be easily irrigated and usually support rich grass pasture, haylands, or are used for irrigated crops and vegetables.

Older outwash plains (pre-Wisconsin?), approximately seventy feet above the younger ones, support quite a different vegetation. Excellent drainage through the porous, gravelly material left little moisture for the growth of more than sagebrush and greasewood. Even these plants are quite widely separated and stunted in growth. Only in wet years is there sufficient moisture to provide grass for limited summer grazing. Both the soil and vegetation, yellow-brown in color, present a marked contrast to the dark green vegetation of the younger outwash material. Irrigation schemes, instigated in Wyoming to water these level surfaces, ended "on the rocks". For example, a floating dredge used in the construction of the irrigation ditches was left stranded on the rocks when the water sank into the sieve-like outwash gravels.

Moraines of different ages appear quite similar, especially in surface configuration. While making detailed development, drainage, and weathering, two divergent types of vegetation were noted. We believe the two types of vegetation are mainly the response to soil development and the availability of moisture for plant growth.

Tree growth from scrub to dense stands of pine is characteristic of the younger moraines. The abundance of rock and paucity of soil coupled with poor drainage in the many depressions are usually reflected by scattered groups of trees. Small patches of aspen, mountain maple, and alder dot the landscape of the dryer edges of the moraines. Where more water is available, even though the soils are both acidic and rocky, the conifers grow in a dense cover. These young moraines then present a rich, green-colored foliage with the exception of the light green patches of the hardwoods on the dryer margins. This dryer condition is especially well developed where the young moraines extend beyond the mountain front into the plains.

The older moraines, though often in close contact with and sometimes buried by the younger deposits, support a still different vegetation. Most of the surfaces are relatively free of

rock, and soil is in various stages of development. Drainage is good in some sections, but other areas show high alkalinity. In Wyoming there are thin deposits of loess on these older moraines. Sagebrush, with an abundance of yucca and cacti and numerous grasses, principally bunchgrass, shows a xerophytic type of adaptation to the lack of available moisture for plants. These xerophytic plants are probably the climax vegetation of these older moraines: only on steep slopes exposed to moisture-laden winds do any tree growths appear, these being dense stands of aspens, poplars, and cottonwoods. Their light green foliage is flanked above by the dark green and silver of fir and spruce which flourish on the unglaciated, higher sides of the valley. This type of contact was found in many places in the Wind River Mountains in northwestern Wyoming.

Conclusions.

Field work along the eastern margins of the Rocky Mountains discloses an apparent difference in vegetation on the varied glacial deposits. These different floras seem to be a logical adjustment or adaptation to diverse edaphic conditions found in the several glacial deposits.

Over the entire area the physical factors are quite similar. The expected decrease in temperature in the higher latitudes is compensated by the decrease in altitude. The rainfall is somewhere near that which determines a tree or grass vegetation; probably this fact allows more control of vegetation through slight changes in edaphic conditions.

The vegetation, though simliar over wide areas of each deposit, is quite different on the diverse deposits. The color contrast is very pronounced and can be readily discerned at great distances.

After careful work in unit areas, it seems logical to expect that these units might be connected and the contact boundaries between two glacial deposits be mapped with considerable accuracy. Since the rugged terrain, limited time, and lack of capital often curtail most field work, the use of vegetation, where possible, promises to be a worthwhile aid in the mapping of Pleistocene glacial deposits.

[1] William C. Alden, "Physiography and Glacial Geology of Eastern Montana and Adjacent Areas," Professional Paper 174 of the U. S. G. S.

Walter E. Kirkendall, "Glacial Features of the Upper Green River Valley, Wyoming." Clark University Library, Worcester, Massachusetts.

Willis T. Lee, "The Geologic Story of Rocky Mountain National Park, Colorado." Government Printing Office, Washington, D. C.

Adjustments to the Climate of the Llano Estacado Region of Texas

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Extent and Character of the Area.

The area included in this discussion is that portion of the High Plains of Texas situated south of the Canadian River. Its extent from this river to its southern border is about 250 miles. The eastern boundary is marked for the most part by a steep escarpment varying in height from 100 to 400 feet above the eroded plains on the east.

This region is a plateau-like area with a generally flat surface pitted in places by shallow depressions locally known as "playa lakes" and scarred by a few deep-cut canyons. The surface gradually slopes from west to east and southeast averaging about nine and one half feet per mile. This area is a treeless or prairie region usually designated as the short grass country. It stands as a remnant of what Mr. Johnson in his classic work, *The High Plains and Their Utilization*, has very effectively described as a great debris apron built

up by the wash from the western highlands.

Climatic Conditions of the Area.

The climate of this section of Texas is classed as the sub-humid and semi-arid phase of the continental type, which means great variability, extremes of temperature, and rather light rainfall, but with the maximum coming in the summer or during the growing season. Cyclonic areas enter this region from the southwest, west, and northwest. As these areas move eastward, rapid and marked changes often occur, particularly in the winter time, due to strong northerly winds resulting from the great pressure gradient in the front of an approaching anti-cyclone. These so-called "northers," however, are of short duration; therefore for a greater portion of the year outdoor activities may be engaged in with little discomfort from cold. Although the summer days may grow warm, on account of the rather high altitude, the nights are usually comfortably cool. The greatest extremes of temperature range from an absolute minimum of -23 degrees F. in the northern portion to a maximum of 112 degrees F. in the southern portion.

The rainfall of the region averages about 20 inches for the area as a whole, the average running a little higher toward the east and a little less toward the west. This amount of rainfall is usually sufficient for successful agriculture, if it is well distributed. Fortunately the maximum comes during the growing season (Fig. 1). However, very much depends upon the character of the rainfall and some other conditions. Often the rain comes in such a downpour that full benefit cannot be derived from the amount that falls, because of the great loss from excessive run off. On account of the latitude, the high percentage of sunshine, the strong light, the low relative humidity, and the strength of the wind, the rate of evaporation is very high, about 60 or more inches per year from exposed water surfaces. The length of the

Average Monthly Rainfall and Temperature
Lubbock

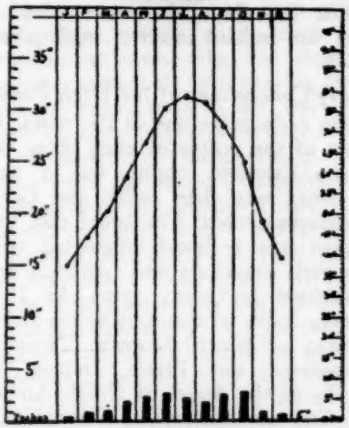


Fig. 1

growing season varies from about 200 days in the northern portion to about 210 in the southern portion. This is sufficiently long for the maturing of most middle latitude crops.

In this area of transition from the humid east to the arid west, man has found himself faced with many problems. It is indeed a land of problems most of which are directly or indirectly climatic. It is the purpose of this paper to show how man has and is now attempting to adjust himself to the varying climatic conditions of this marginal area.

Adjustments of the Indians.

The first people to face the problems of the Llano Estacado and adjust themselves to its exacting conditions were the Indians. They had been attracted by the buffalo and other game which in turn had been attracted by the splendid grasses which this area afforded. After the Indians learned to use the Spanish pony, they became expert in the chase and in their own defense. The Spanish pony had come originally from Arabian stock and easily adjusted itself to the conditions of these plains. Here they increased and thrived, becoming animals of great strength and endurance. The Indian,

likewise a product of exacting natural conditions, became master of the pony and was probably master of these plains for about three centuries. It was an Indian country until about 1875.

Early Conceptions of the High Plains.

On early maps and in the minds of most of the people of early days, the Llano Estacado region was a part of what was then called the Great American Desert. The belief that this region was a desert originated with the early travellers and explorers and continued for many years. In 1849 Marcy spoke of this area as the Great Sahara of North America. Thwaites considered the Plains Indians as Arabs of the desert of North America. To some this region seemed best fitted for the haunts of the mustang, the buffalo, the antelope, and their migratory lord—the Plains Indian. In the census report of 1880 some one who was said to have carefully explored this section of Texas reported that not more than 7,000,000 acres of the Llano Estacado within the state of Texas was an absolute desert. This so-called desert served as a great barrier to movements to the far west. Maps showing the westward movement of people across the United States show a halt along the ninety-eighth meridian. Beyond this line those seeking new agricultural lands met cilmatic conditions with which they were not prepared to compete. Here the agricultural frontier was arrested until methods and means of overcoming some of the climatic handicaps could be devised. In the meantime the ranchmen came in.

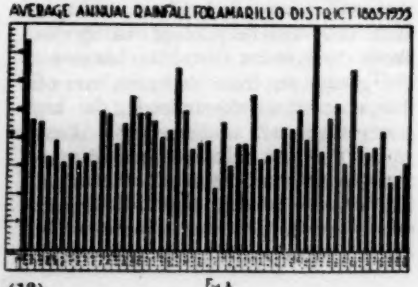
Adjustments by the Cattlemen.

Recognizing this great expanse of short grass country with its rather mild climate as an excellent cattle country, the cattlemen took possession for a while. The early eighties were the cattle-boom years. This area became a part of the great cattle kingdom consisting of the ranchmen, cowboys, Spanish ponies, and longhorns. The chief basis of this kingdom was the grass provided primarily by the climate of the region. The earliest ranchmen who had first choice of ranch lands selected lands including considerable areas of canyons and breaks, if possible, because these would assure a water supply and in winter offer protection from cold and provide winter pastures. It seems probable that the peculiar characteristics of the Spanish pony and the longhorn cattle and their adaption to the conditions of the plains played no small part in the early settlements of these plains.

Adjustments by the Farmers.

In the late eighties after a series of years of rather abundant rainfall including that of 1885, which was 37.07 inches in the Amarillo district, one of the heaviest that has been decorded (Fig. 2), the farmers who had been waiting on the border of these plains for some years, began crowding in upon the cattlemen. But they happened to come at the beginning of a series of dry years from 1888-1895. These years proved to be so extremely dry that the inward movement was arrested and a heavy emigration resulted. Dr. Webb in his splendid work, *The Great Plains,* speaking of the western movement of the people, very effectively dscribes the conditions, which here obtained, in the following quotation:

"As one contrasts the civilization of the Great Plains with that of the eastern timberland, one sees what may be called an institutional fault (comparable to a geological fault) roughly following the ninety-eighth meridian. At this fault the ways of life and living changed. Practically every institution that was carried across it was either broken and re-made or else greatly altered. . . . When people first crossed this line they did not im-



mediately realize the imperceptible change that had taken place in their environment; nor, more is the tragedy, did they forsee the full consequences which that change was to bring in their own character and in their mode of life. In the new region—level, timberless, and semi-arid—they were thrown on Mother Necessity into the clutch of new circumstances. Their plight has been stated in this way: East of the Mississippi civilization stood on three legs—land, water, and timber; west of the Mississippi not one but two of these were withdrawn—water and timber—and civilization was left on only one leg—land. It is small wonder that it toppled over in temporary failure."[3]

While this has been said of the Great Plains as a whole, it can be applied with full strength to the Llano Estacado region. We of today, as a rule, do not realize with what faltering and wandering steps man struggled in establishing himself in a new home in a very different environment. By trial and error little by little some progress was made in these marginal lands. Although the early settlers were turned back again and again in this region of apparent agricultural insecurity, in many cases they were sufficiently encouraged by the abundant yield of some of the more favorable years to weather the storms of unfavorable years, believing that the next year would bring again abundant harvest.

Finally, aided by new inventions and discoveries, farmers were able to make more satisfactory adjustments. With barbed wire the lands were enclosed and divided into sections. These divisions created a need for more watering places. Well drilling machinery was installed and windmills were erected to utilize the winds to pump the water. This assured a water supply to a thirsty land.

As a result of further scientific studies and explorations, it was discovered that the average of about 20 inches of rainfall or even a little less could be depended upon for the production of crops if dry-farming practices were adopted. The introduction of drought resisting crops such as grain sorghums and sudan grass, which usually produce fair crops even in years of rather low rainfall, helped to make farming more secure. When it had been proved that a given acreage of grain sorghums would produce many times as much feed as a given acreage of buffalo grass, even the original cattlemen, who had thought that this could only be a grazing land, saw the dawning of a new day—the breaking up of big ranches and a different system of stock raising. For many years the extent of agricultural development was scattered and very limited in extent, but it had made a substantial beginning. In time smaller ranches and better grades of cattle made their appearance. The Hereford, a hardy active animal, a good rustler, and one capable of weathering adverse conditions, proved most satisfactory. In cultivating the land the use of big machinery made possible considerable returns from vast acres because of low cost of production, even if production was low. Through experiments it was discovered that some crops of the more humid areas could be successfully grown by modification of farm practices common in humid regions; for example, that by sowing about half as much wheat per acre as was the custom in regions farther east they could secure a fair yield with the available moisture, that by cultivating the corn with tools suited for shallow cultivation they could grow some corn particularly in the South Plains, that by leaving cotton thick rather than thinning it as is usually done in the main cotton belts they could hasten the maturity in a rather short season and secure a good yield.

During the nineteen-twenties when the average rainfall ran a little above that of the general average of wet cycles (Fig. 2) and prices of crops were rather good, the people of these plains were unusually prosperous. New types of labor-saving devices were being supplied by the industrial east, and as in most other parts of the country, the people became somewhat intoxicated on prosperity. They were thinking chiefly of personal interests and private gains. They felt that they had made themselves masters of the

situation, that the conquest of Nature was about complete, and that they were quite secure. There were some who still believed that when they plowed up the land there would be an increase in the rainfall. They seemed to lose sight of the fact that more than likely cycles of dry years would come as they had done in the past. In the thirties they found themselves caught in a maelstrom of unusual intensity, its forces being determined by both economic and climatic conditions. They were faced by low prices and poor markets on one hand and by drouths and crop failures on the other. They became involved in the grimmest battle for existence which the people of their generation had hitherto been called upon to face. They began to realize as they had not before that Nature must have her way. They now recognize the truth of the following statements:

"Nature is not to be conquered save on her own terms. She is not conciliated by cleverness or industry in devising means to defeat the operation of one of her laws through the workings of another. She is a very business-like old lady, who plays no favorites."[3]

The people of this area have a particular fondness for these plains and have become so firmly rooted that most of them are unwilling to retreat. In pioneer fashion they have been accustomed to fight their own battles, but the continuation of both depression and drouth has forced them to call for help from different governmental agencies. The experiences of recent years have taught them many lessons. They are realizing as they have never done before what is well expressed in the following quotation from the Great Plains Committee:

"We know now that it is essential to adjust agricultural economy on the Plains to perils of deficient rather than abundant rainfall, and to the destructive influence of wind blowing over dry loose soil rather than primarily to a temporary high price for wheat or beef; that it is our ways, not Nature's, which can be changed."[4]

The county agents are rather encouraged over the cooperation they are securing in their agricultural programs from the land owners. Some operators who do not own the land do not cooperate so well, as a rule. The agents of this area believe that they have the situation rather well in hand now if wheat prices do not go too high, and they can be permitted to carry on the program they have started. They are striving to control erosion and conserve moisture by listing and furrowing with the contour, contour plowing, terracing, chisseling, summer fallowing for some crops, rough tillage, strip cultivation, providing cover crops, and building storage dams.

In the shallow water belts some irrigation from water pumped from wells is being practiced. New types of equipment at lower costs is making irrigation profitable in some cases. There are some doubts, however, about the wisdom of pumping out very much underground water for irrigation. At present there are no state laws to regulate the number of wells in a given area and very little is known about the water supply. Men are now in the field making studies of this problem. It seems evident that the ground water of this area is dependent upon the rainfall of the region. Recent investigations indicate that about half an inch of water a year escapes evaporation and absorption by the vegetation and percolates through the soil to the ground water body. Considering these facts, it does not seem that the underground water supply will permit very much irrigation.

A more complete adjustment to the climate by the farmers of this area will require long time planning with much detailed study and experimentation. But above everything they must have the cooperation of all the people for it is not an individual matter.

Architectural Adjustments.

Climate is one of the very important factors to be taken into consideration in architectural planning. In this region some architectural problems have been solved but much yet remains to be done for a more complete adjustment. The early white settlers resort-

ed to the use of the dugout and sod house. These were well adapted to the environment. They were cool in the summer and warm in the winter. They were small, but since climatic conditions permitted an outdoor life most of the year, the small shelter was usually adequate. Many later settlers have built types of houses similar to those of regions from which they have come or types represented in pictures which were attractive but often not adapted to the environment; therefore some are misfits.

The dry atmosphere of this region, the strength of the winds, the dust storms, the range in temperature, the strong light, and the lack of vegetation deserve due consideration in the materials used and in the types of houses constructed. The Spanish, the pueblo, the bungalow, and what is sometimes called the Chicago or two-story bungalow types prove to be most appropriate. Where there is so little rain and snow, steep roofs are not needed, and rooms under steep roofs are too hot in the summer. The flat or low vaulted roofs are better in high winds and fit into the landscape of the region. The overhanging eaves and comparatively small windows protect from the glare of the sun. Thick walls protect from both heat and cold, and to some extent from dust. A dust-proof house has not yet been devised but progress is being made in this respect. Because of the rather short summers and high winds, spacious porches are not needed as they are farther east and south.

The naturally soft and quiet range of colors of the region do not permit too bright colors in paints. An interesting experiment is now being conducted to determine the type of paints best suited to this region. At present it seems that the sudden changes in temperature and the effect of these changes upon the contraction and expansion of building materials, the strong sunlight, and the dry atmosphere have marked effects on the endurance of paints. Some of the manufacturers think they are finding that a synthetic base rather than one of oil is going to prove more satisfactory. An experimental unit is located in this region and some houses are being painted as tests.

Not many very pretentious houses have yet been built in this section. even in the cities and towns the houses are rather small but comfortable and home-like, and in most cases are types appropriate for the region. Most of the rural homes are rather small but neat farm homes, usually of the bungalow type. Since the weather permits the live stock to graze out all the year, most of the barns are rather small. A solid board fence is built on the windward side of the barn and corral for the protection of the live stock kept about the barn. More and more trees are being put out for shade and for wind breaks. In a region of so little rain, feed may be stacked in the open and little protection is provided for the machinery; therefore, little loft or storage space is provided in connection with the barns.

Characteristics of the People.

Any new-comer into this region cannot but help but note the courage with which the people face adverse conditions. People in the more humid regions who have been schooled under less severe conditions would be so despondent and so overcome by the losses and failures which these people endure that life would be no pleasure to them nor to any who had to live about them. Not so with these people. They go happily on believing that a better day will come.

The settlement of this Llano Estacado region has been one of periodic advance and retreat depending upon the climate. Each advance has carried them a little farther west and each retreat has been a little less complete. Thus by a selective process there remains a courageous, optimistic, and adjustable people.

BIBLIOGRAPHY

[1] Johnson, The High Plains, Twenty-first Annual Report of the United States Geological Survey, p. 615.
[2] Webb, The Great Plains, pp. 8-9.
[3] Sears, Deserts on the March, pp. 3-4.
[4] Report of the Great Plains Committee. The Future of the Great Plains, U. S. Government Printing Office, Washington, D. C.: 1936, p. 64.

Land Utilization in Judith Basin, Montana

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Mountain-girt Judith Basin, famous, originally for cattle grazing, and, more recently, for wheat raising, lies in the northern Great Plains, almost in the geographical center of Montana.

Koeppen classifies its climate in the cold, dry steppe type. Although situated in the heart of the short-grass country, it supports vegetation prevailingly of the tall-grass associations. Soils, which vary from gravel to silty loams, are underlaid by 25 feet or more of limestone gravel which ranges in depth from at the surface in the southern part to 15 feet below it in the northern. Lime cement consolidates the upper three or four feet of gravel into conglomerate.

Topographically the Basin comprises three sets of broad, flat-topped to slightly-rolling, gently-sloping benches separated by narrow bench fronts commonly too rough for cultivation. River valleys, canyon-like in the central and northern portions, broad and open elsewhere, are bordered by narrow zones of rough land.

Three distinct periods form the history of land utilization in Judith Basin; viz., hunting-trapping to 1880, stock grazing from 1880 to 1905, and wheat raising after 1905. Geographic bases for the earlier two forms of land use were the luxuriant cover of nutritious grasses, abundance of water in springs and streams, and shelter provided by forests and canyons of the encircling mountains. All three have been characterized by destructive exploitation of the resources of the area.

Sheep and cattle entered the Basin together in 1879. Cattle ranked first in importance until 1897, after which sheep were the more important. A series of mild winters, abundance of cheap but nutritive grass, high prices relative to low cost of production and construction of Northern Pacific Railroad to Billings in 1883 resulted in rapid expansion of the cattle industry to its peak in 1886 by which time the range was over-stocked.

Severe drought during summer of 1886 followed by the worst winter in the history of the range in 1886-87 resulted in the loss of 75 to 90 per cent of the cattle. Building of Great Northern Railroad to Fort Benton and Great Falls in 1887 helped revive the industry, but it never regained its former glory. The severe winter of 1892-93 killed 40 per cent of the cattle. Drought during summer of 1893 resulted in light-weight cattle which brought low prices. In 1897 cattle brought good prices because large grain crops in the central states created a demand for feeders.

In addition to handicaps placed upon it by its own over-expansion, by drought, and by severe winters, after 1905 the livestock-grazing industry began to suffer from pressure of settlement and contraction of the range. By 1912 free range had disappeared.

Agricultural development in Judith Basin is divided into two periods. Prior to 1905 agriculture was largely of the small-scale subsistence type; but after 1905 it changed rapidly to a strictly commercial, wheat-raising type.

The first wheat farmer homesteaded near Moore in 1904, one year after the first railroad entered the Basin. The wheat boom from 1908 to 1918 grew out of a combination of favorable geographic and economic factors. Rainfall from 1904 to 1916 inclusive was markedly above normal, which, in combination with exceptionally fertile virgin soil, resulted in phenomenal yields. Slowly rising prices for land and wheat and increasing population pressure in eastern United States provided economic incentives. Cheap, but highly productive, land was available in Judith Basin. Entrance of railways after 1908 provided transportation to market for bulky grain, thereby removing the last barrier to operation of other factors,

and settlers poured into the Basin. Toward end of the period the World War, with its rising prices for wheat, meat, and wool—the three cash commodities of the Basin—provided an additional stimulus.

Transformation from stock-raising to wheat-growing region took place, for most part, between 1910 and 1912. Homesteaders were interested only in wheat—the golden flood. All land, topographically tillable, was planted to wheat. Edaphic conditions, unless extremely unfavorable, were disregarded. Wheat alone was produced—everything else needed on the farm was purchased. Bumper wheat crops in 1914-15-16 resulted in increased efforts to get more land into wheat.

It was a period of prosperity, largely false because based to a great extent upon borrowed capital, not upon wealth produced in the Basin. Seeds for its collapse were sown while it still prevailed—over-population, over-development, excessively expanded wheat acreage, and credit, mortgage indebtedness, and land values inflated beyond all relationship to productivity of the land.

Nature, formerly so beneficent, intervened cruelly and drastically after 1916. A three-year drought began in 1917, culminating in 1919, one of the driest years in Basin history. Partial crop failure in 1917 and 1918 was somewhat offset by high prices, but nothing could compensate for complete failure in 1919. On the heels of drought came economic depression, and low prices from 1919 to 1923 completed the ruin begun by drought.

Cattlemen, sheepmen, and wheat growers were caught alike in the meshes of adversity. The years from 1919 to 1923 constituted a period of liquidation. Everything marketable was sold, and when this failed to cancel indebtedness the land was turned over to the creditors. Large numbers of farmers left the Basin, although many remained on their former farms as tenants or managers.

Land abandoned by its owners did not go out of use but was taken up, on lease or purchase, by the more successful ones who remained.

Recovery began in 1924. Crops were good that year due to favorable climatic conditions and prices were relatively high, a combination of conditions that continued for the next five years. Another land rush, smaller than the first and involving fewer men inexperienced in farming, began. Credit was once more extended liberally, not by banks which had learned their lesson, but by machinery companies. Strictly commercial wheat farming continued dominant because of favorable geographic conditions and of the many farmers who refused to do anything else. Farmers again went heavily into debt to buy land and machinery.

Once more, beginning in 1929-30, drought and depression intervened to destroy the apparent prosperity. The drought is still unbroken, the depression—well, use your own judgment.

Increasingly serious feed shortage has marked every year since 1932. Livestock have decreased in number in response to lack of feed and financial pressure. At first sheep were sold more heavily than cattle, but today the tendency is to sell cattle and hold sheep—a response to feed and market conditions. Flocks and herds are composed largely of young animals and breeding stock. General increase in livestock is retarded by feed shortage and lack of water, particularly surface water and shallow ground water in areas some distance from mountains or permanent streams.

Chickens and turkeys have increased in number as a result of ease and cheapness of production—grasshoppers are excellent for fattening—and generally good returns.

Crop failure, partial or complete, has characterized every year since 1929. Some land, taken out of wheat production, has been devoted to forage crops, but most of it lies idle. Acreage in forage crops has decreased. Winter wheat, chief type prior to 1916, because of heavy winter-killing after 1916 due to severe

cold, drought, soil blowing, and foot-rot, was replaced in first place by spring wheat. Since 1929, consequent upon the fact that the long time average yield of spring wheat is less than that of winter wheat, the latter has again taken first place.

Long continued drought has resulted in serious shortage of soil moisture and of water for human and livestock consumption. If water shortage becomes much more acute some sections will be uninhabitable because of lack of water.

Irrigated acreage is slowly expanding; but, because of unfavorable geographic factors, it can never constitute a large proportion of total farm acreage. Nearly every farm, however, could have enough irrigated acreage to be self-supporting.

Divrsified farming has developed slightly. Easy credit and the psychology of the wheat farmer—a determination to live on 30 days' work a year—expanded wheat acreage. Inflated credit, mortgage indebtedness, over-investment in land and machinery, and government aid kept it expanded until relentless drought and depression forced contraction. Now, a high proportion of farmers are awaiting the first opportunity to return to strictly commercial, mechanized wheat farming, and thus overexpand wheat acreage once more.

Severe soil blowing constitutes a most serious problem in Basin agriculture. Over large areas, particularly in the south and west, it has practically destroyed the soil. Elsewhere it is an important factor in decreasing soil productivity.

Land abandonment, a response to original shallow soil cover and to soil blowing, has taken place extensively in the south and west. On South Bench abandonment began four years after settlement and is now almost complete. In bottomlands of streams in the central portion, heavy, compact, alkaline soils have caused considerable abandonment.

Wheat acreage should be reduced, on the whole, about 50 per cent. Then despite disadvantages cited, because of slight climatic advantages, level topography, fertile soil, and better water supply, Judith Basin will remain one of the best ranching and farming areas in the northern Great Plains.

Historical Geography of Russian America

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Historians of the Pacific Rim have long recognized that Alaskan history through the days of Russian occupation was more a closing chapter of Russian expansion than an opening chapter of new world development. Threads of the Slav race to the Pacific extend as far back as 1573 when a punitive expedition against a band of offending Cossacks started a population movement eastward that came only to a momentary rest on Kamchatka Peninsula in 1713.

The natives of Kamchatka had no knowledge of America, hence it was by local evidence that the Russians deduced that there must be land lying to the eastward.

Perhaps no other part of the globe remained in such confusion and uncertainty as did the North Pacific during the seventeenth and the first half of the eighteenth centuries. Arm-chair cartographers had the Pacific plastered with mythical Straits of Anian separating Asia and America, as well as numerous legendary islands. Cartographic speculation, coupled with the reports from the Russian traders on the east coast of Siberia, caught the fancy of Peter the Great, and impelled him, as one of his last official acts, to send out an expedition in search of any passage that might exist between Asia and America. He chose Vitus Bering, a Dane in the service of the

Russian navy, to head the expedition. It took Bering six years, from 1725 to 1731, to cross Siberia with his supplies, build a boat, sail up to East Cape which had already been visited by land, and report back to St. Petersburg his conclusion that Asia and America were separated.

The Empress Catherine, Peter's successor, was favorably impressed, however, and ordered a second expedition to carry out the rest of the original plans.

In June of 1741 two small ships were launched from Kamchatka and the second expedition was inaugurated. The two ships kept together for a few days, then partly due to bad weather and partly to ill feeling between the chief and his aide, they separated. Chirikof, the commander of the assisting vessel, actually discovered Alaska on July 15 near the present southern boundary. Bering first saw land the following day. Almost no records were made and no actual exploring was done by either ship, although they arrived at the most favorable time of the year for Alaska.

Chirikof returned to Siberia after two months of suffering from storms and scurvy. Bering dallied along through October and November, months ushering in winter and maximum storm activity in the Aleutians. Rain, fog, wind, rotten sails—grievances all magnified by scurvy—completely demoralized his crew. The flag ship was finally wrecked on the Commander Islands, off the Kamchatka coast, where Bering failed to survive the winter. The following spring a smaller boat was constructed from the wreckage, the men gathered up a few hundred furs of the sea-otter, taken during the winter, and finally returned to Kamchatka. The voyage of discovery of Alaska ended disastrously, but the chief reason was not the inhospitable environment of the Pacific Northwest coast, it was the inadequate food and supplies due to Siberian distance.

The Period of Sporadic Fur Trading.

Bering's achievement in reaching the Alaskan mainland was quite overshadowed, however, by an accidental consequence of the voyage. The Russian government, disappointed at the extremely unfavorable reports, kept the records of the expedition secret for many years. Nevertheless an immediate sensation was created by the makeshift fur garments and blankets that the castaways brought back. Chinese merchants at Kamchatka offered fabulous prices for them. The returned sailors managed to gather together nearly $100,000 worth.

Almost immediately traders scurried from Kamchatka to the Commander and Aleutian islands. In general they sailed in unseaworthy craft, built of green timber and without iron, the planks in many instances being fastened with deer thongs and calked with moss and tallow.

After a few initial attempts and with sea-otter selling at from $150 to $200 apiece, hundreds of riff-raff adventurers of Siberian exile engaged in the trade. Many times their ships fell to pieces in a gale and the Russians went to the bottom, or stranded among the Aleutian Islands. It has been estimated that one out of every three ships that set out was wrecked, and many lives lost, yet as many as 20 ships a year visited the islands, and the rich potential profits seemed adequate compensation for the hardships and hazard.

This period was one of unregulated hunting. Practically every vessel was owned by a different individual who was responsible to no one. Cut-throat competition was the order of the day. The first expeditions were provisioned with cargoes of articles of trade, but the cost of transporting such articles across Siberia was prohibitive, so trade soon gave way to a more economical and effective method of obtaining furs. Natives were impressed to hunt for the Russians. Either by force or agreement they were required to give hostages, generally the more attractive women, to ensure

safety for the Russian traders and a bountiful supply of furs. The natives were given practically no compensation for their work, and many abuses and outrages were heaped upon them and the hostages. By the middle of the 1760's the Aleuts revolted and Russian blood flowed. In retaliation whole villages of Aleuts were wiped out. These inexcusable atrocities were contrary to the expressed instructions of the government, but as the Russian proverb put it, "Heaven is high, and the Czar is far away."

The Period of Company Rule.

This "promyshleniki reign of terror" lasted until about 1773, when the traders, seeing the advantage of working together, largely as a conservation measure, began to unite into large companies and to obtain imperial ukazes for exclusive privileges of monopoly.

For nearly forty years after the discovery of Alaska the Russian fur trade had been confined chiefly to the Aleutian Islands. As long as the supply kept up the Russians remained there, but as the animals began to disappear under a tremendous prosecution, there was a tendency for the hunters to roam farther and farther from the original grounds. Thus far Unalaska was the nearest approach to an Alaskan headquarters. Pure exploitation had been the objective. No attempt was made to establish a permanent settlement. Trade was engaged in only from the boats.

The first settlement was made in 1783 under Shelikof, a Russian official who saw the depletion of resources in the Aleutians, and who also saw the need for a permanent station where supplies could be accumulated and stored. He chose Three Saints Bay on Kodiak Island, although the headquarters were soon removed to the north end of the island at the present town of Kodiak, partly for a better harbor and partly because of a forest site for lumber. Shelikof also knew that if success of a lasting nature was to be achieved organization and leadership was needed. He chose as governor, Alexander Baranof, a Siberian merchant adventurer.

It was clear to Baranof that rivalry and competition were draining the country of the valuable staple upon which rested the very existence of the scheme of colonization. In order to widen operations ere the field was exhausted, Baranof urged consolidation of the various companies to increase working capital and efficiency of operation. Through a masterpiece of bluffing he finally succeeded in removing his last remaining competitor, and the founding of the Russian-American Company resulted. The Company was clearly more than a commercial venture. It was practically an independent department of the Russian empire, and counted among its shareholders members of the imperial family. Its earnings for the first twenty years of its existence were almost six million dollars.

The home office until 1799 was Irkutsk, after which it was removed to St. Petersburg. This stretch of thousands of miles between the home office and the field of operations was a tremendous handicap for the company's traders, especially when England and the United States entered the field, and was the key factor in the ultimate downfall of the Russian American empire.

The economic problems faced by the company were tremendous. Furs had to be shipped to the home office and from there distributed to Europe and China. This disadvantage was further increased by the fact that the company had to receive all its supplies from Russia, overland across Siberia. Notwithstanding the company's wealth, the settlements were often threatened with famine. The traders themselves knew nothing about agriculture and deliberately sent up into the cold Yakutat Bay region the only agricultural colony that was sent to Alaska, dooming it to complete failure. The eyes of the Russian-American Company were on furs and furs alone.

Foreign competition, together with a growing scarcity in the Kodiak region, caused in time a migration farther east and south. Here the Russians came into direct competition with both British and American traders. If Russia was to hold its territory and its trade, it was evident that the capitol would have to be moved eastward, across the Gulf of Alaska. Sitka became the center of government shortly after the turn of the nineteenth century.

But the advantage continued to be with the British and Americans. They enjoyed comparatively easy communication with their home ports. They came in large well-equipped vessels, laden with goods far superior to anything the Russians could afford to bring by sled or on horse back across Siberia. Russia had a most inadequate merchant fleet and lacked the bases for a profitable exchange trade. The Americans were particularly fortunate in this respect, and actually established for a time a triangular trade that compared in extent with the triangular trade of the Atlantic. The "Boston men" came into the Pacific, bought furs at high prices, took them to China, and exchanged them for tea, silks, and handicrafts for the East Coast.

It was seen that the Russians would have to become more self-sufficient, in an effort to meet this type of competition Supply ships were still very irregular. Sitka, as a Russian capital, existed in barbaric splendor, but was still on a living standard not above that of the native Tlingets. A few supplementary supplies from American ships could give temporary reilef, but New England could not regularly export food stuffs around the Horn to the Northwest Coast. California was the logical source, but Spanish law forbade any traffic with Russia. Excellent reports, however, were brought to Sitka regarding California's productivity, which made Baranof decide to establish a California station, which would not only supply agricultural produce for the Russian American empire, but would also serve as a basis for fur operations in Spanish waters.

Bodega Bay was selected as a suitable site. In 1811 a wharf and warehouses were established. The settlement was located 18 miles above the bay, however, in the valley of the Russian River, where the advantages of soil, timber, water, and pasturage were better. After the foundation of Ross Colony, as it came to be known, about 30 men of Russian blood and 50 to 120 Aleuts were established there. The results of the Ross Colony were not very satisfactory. Agriculture was disappointing. Land was limited in extent and not particularly fertile, while the prevalent coast fogs caused the grain to rust. The best grain land was in the interior and was held by the Spanish. Perhaps the main reason for the colony's failure, however, was the stupidity and ignorance of the Russian traders and Aleuts, who lacked an agricultural heritage and who were therefore the world's worst farmers.

During this same period the Russians also kept up an establishment at the Farallone Islands, off the California coast. The chief object of this outpost was to secure fur seals. After 1818 the seals diminished rapidly, although a group was stationed there to kill sea lions, gulls, and to collect gull eggs for food, and to prepare down for bedding, and skins an sinews for making Aleut bidarkas, or hunting boats.

The level of development and the attitude toward the two colonizing ventures in California waters, indicate better than any other feature of Russian economy in North America, the almost savage and uncivilized standard of living that prevailed, in spite of the baronial grandeur that surrounded Baranof and his court at Sitka.

Toward the end of company rule, diversified industries were beginning to develop around Sitka that might in time have succeeded in making a true colony out of Russian Alaska. Turpentine was secured from the trees, iron was taken in small amounts

from the hills, ship building was developed, and a brass foundry for casting bells was established.

In spite of this type of development profits in furs steadily declined. Stockholders in the Company demanded dividends that were no longer forthcoming. In 1818 Baranof was removed as governor, and the period of Company Rule came to an end.

Russian Governmental Control.

After Baranof's dismissal the Russian Navy took charge of the administration of Alaska, attempting to save a tottering empire that the Company was no longer strong enough to hold. The short-sighted policies of the Russian Government, however, only hastened the colonial decline. An effort was made to bar foreigners instead of using them for profit. The ukaze of 1821 attempted to make the Russian possessions north of 51 degrees, a virtual closed sea. Although this drastic measure was rescinded in 1824, Russia in America lost ground steadily under navy administration.

The chief interest that Russia had in North America was furs, and that resource was rapidly failing. Other minor industries were developing, but none of them seemed important to a Company and a Government intent upon profits from furs. The resources and adjustments that today provide nearly 98 per cent of Alaska's wealth were either completely overlooked, or the time was not ripe, economically speaking, for their development. During the latter years the Company conducted costly explorations for minerals and officially announced that none existed in paying quantities. Fish and fishery products, amounting now to 65 per cent of Alaska's annual exports, are not even mentioned in Russian American records. The agricultural valleys of Matanuska and Tanana, as well as the reindeer grazing grounds of the Seward Peninsula, were completely unknown to the Russians.

With a serious decline in furs, around the middle of the 19th century, Alaska now became a burden to Russia, unable as she was to compete in a rising cost market with centrally located commercial powers. It was evident by 1860 that Russia would be wise to get rid of her North American province even at a financial sacrifice. Furthermore, the Hudson's Bay Company, seeking land furs, had literally forced a large territorial lease in Russian America, and Russia didn't want England to get Alaska. In 1867 events came to a head. The lease of the Hudson's Bay Company was up, and the company was negotiating for a renewal. Russia was eager to end relations with the British company. As a result she was immediately interested when the United States started negotiations for purchase.

With the lowering of the Russian flag and the raising of the Stars and Stripes in 1867, Russia's part in Alaskan development came to an end, and Russian America faded from the scene.

From the standpoint of the United States the interest in Alaska was chiefly political. The only economic interest lay in the developing fisheries of the Pacific Coast, particularly whaling. In the face of this fact one can only conclude that the purchase of Alaska was not done with any sense of far-sightedness on the part of the United States, yet almost by stumbling into a treaty, the nation attained something far greater than even Seward ever dreamed.

Summary and Conclusions.

One can perhaps summarize the historical geography of Russian America best by reviewing briefly the outstanding events and stages in the development of Alaska through the period of Russian occupation.

1. In the first place the discovery and early development of Alaska was a closing chapter in Russian eastward expansion.

2. Sea-otter wealth was the lure that led to the overrunning of the North Pacific by the Russian traders.

3. Conservation of sea-otter led to

the formation of the Russian-American Company.

4. Distance from Russia—6000 miles from St. Petersburg to Kamchatka—made it impossible for the Company to compete with foreign traders more centrally located and possessing the bases for a significant triangular trade.

5. In an effort to become more self-sufficient and less dependent upon Siberian distances, Ross Colony was founded in California. The California colony was only partially successful because of poor agricultural location and a lack of agricultural heritage on the part of the Russian colonists.

6. Finally, the Russian American Empire fell with the decline of the monocultural economy—the sea-otter—that supported it.

Russia tried to exploit Alaska as an investment rather than as a colony. The entire structure was based on furs, with great profits and small capital invested. No evidence of real stability is to be found in the Russian colonial policy. A transplanted culture of nomadism and ruthless exploitation succeeded only as long the furs lasted. Almost no effort was made to intelligently adjust to the permanent environmental resources of the country.

Water Power Development on the Loup River in Nebraska; A Study in Economic Geography

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The state of Nebraska has no Grand Canyon in which to place a dam 700 feet high. It has no precipitous valley walls to form a natural reservoir holding 30 million acre feet of water. It has no Grand Coulee with a sharp declivity of 400 feet over which its rivers can be diverted. In brief, it is not conspicuously adapted for hydroelectric development. And yet, Nebraska is not destined to be forever a blank spot on the water power map of the country. The three projects under construction by the Public Works Administration in our state—the Central Nebraska Public Power and Irrigation District project near Hastings, the Platte Valley Public Power and Irrigation District project near Kearney, and the Loup River Public Power District project near Columbus—are expected to make the state practically self-sufficient in electrical power. It is the third of these projects that I am describing.

The streams which flow eastward across the gently-dipping sedimentary strata in Nebraska have not cut deeply into their soft beds. Instead, they have preferred to erode mostly in a lateral direction, forming valleys commonly several miles wide and only 100 to 300 or 400 feet below the adjacent uplands. Broad alluvial terraces frequently extend for many miles along the valleys, little dissected by the minor drainage streams which cross them in reaching the rivers. These terraces, especially in the western and central parts of the state, have long been used for irrigation farming. A new use has been found for them in the last five years. They are fundamental in the development of hydroelectric power along the low-gradient streams.

The Loup River Public Power District project was made possible by a number of PWA loans and grants totalling about $12,000,000. Actual work on the project was begun in the autumn of 1934 and completion is expected by December, 1937.

Physically, the project involves the diversion of water from the north side of the Loup River, at a point about six miles touthwest of Genoa, into a low-gradient earth canal 35 miles long. (Fig. 1.) The canal is designed over most of its length to carry 3,000

second feet of water, or somewhat more than the average flow of the river. This canal carries the water across the flood plain and onto the terrace, from where it is dropped twice to turn turbines before it is finally led back into the Platte river, three miles southwest of Columbus, just below the confluence of that river with the Loup. The first of the two power houses, located one mile northwest of the little village of Monroe, utilizes a head of 32 feet to develop 9,600 horsepower through three hydroelectric units. The second and larger power house, built on the south edge of a high terrace, about two miles northeast of Columbus, uses a head of 112 feet to generate 54,000 horsepower in three turbine units each of 18,000 horsepower capacity. The flow of water into the Columbus plant is controlled by a 1,000-acre artificial regulating reservoir, the lower end of which is about a mile above the power house.

Electricity generated by these two plants, at Monroe and Columbus, is to be distributed throughout much of eastern Nebraska by a system of transmission lines, not only to the larger cities and towns but also to many rural districts not previously supplied with electrical power. It is hoped that this new supply of cheap power will attract new capital and new industries to the area, and furnish to the people already living there new economic strength and greater possibilities for cultural development.

Four major factors of the natural landscape have served to make feasible, from an engineering viewpoint, the construction of the project in its present dimensions. These are:

1. The regularity of flow of the Loup River.

With an average seasonal flow of nearly 2,500 cubic feet per second, the Loup River is the largest tributary of the Platte system below the confluence of the North Platte and the South Platte. It also has the largest drainage basin to be entirely included within the boundaries of Nebraska. During the late summer and autumn months when, because of underground removal, diversion for irrigation, and surface evaporation, the Platte River below Grand Island is dry or nearly so, it is water from the Loup and, to a lesser extent, the Elkhorn which gives the Platte River a semblance of respect as it debouches into the Missouri.

Unlike most of the rivers of the Great Plains, the Loup is remarkably regular in its flow throughout the year. The reason for this regularity is to be found in the nature of the headwater area, the Sand Hill Region. The Sand Hill Region of Nebraska is known throughout the Middle West as an excellent pasture land for thousands of beef cattle, and as a fine place to fish and hunt wild ducks. Freshly-weaned calves and 12-gauge shotguns give the Sand Hills a characteristic voice not common to the more prosaic farming areas to the east of it. The silent role of the Sand Hills is not so well appreciated, but it too is of great importance, for, by absorbing into its sandy surface all the precipitation which whimsical clouds care to yield, this region adds appreciably to the ground water reserve of neighboring regions on the east and south. Hundreds of marshes, shallow lakes, and springs, maintained

by water slowly seeping through porous sands, furnish the tributaries of the Loup River a steady supply. In the upper reaches of these tributaries the water level varies only a few inches throughout the year, and above its confluence with the less dependable Platte, near Columbus, the lower Loup is still strikingly uniform in its seasonal discharge. It is the best regulated river of its size on the Great Plains, and because of its regularity the Loup River Public Power District did not find it necessary to go to the expense of constructing a large storage reservoir for its hydroelectric plants. (Fig. 1.)

2. The configuration of the Loup Valley.

The Loup River in its lower course is a shallow stream with a channel width usually less than 1,000 feet. Its flood plain units with that of the Platte near Fullerton, about 15 miles above Genoa, but the actual channels of the two streams do not converge until below Columbus. Outside of the flood plain, along most of the course between Genoa and Columbus, the Platte-Loup Valley is bordered by one or more alluvial terraces, formed by the Platte River during earlier stages of valley development. The highest of these terraces along the route of the Loup power canal is the Shell Creek Terrace, which extends eastward from north of Oconee for about 40 miles, or to beyond the town of Schuyler. This broad Shell Creek Terrace, the surface of which is from 75 to 100 feet above the flood plain, is of great importance for the Loup River Public Power District project, since on its level to gently undulating surface is located Lake Babcock (the regulating reservoir), and at the base of its steep southern front is the Columbus power house.

The north side of the valley is admirably adapted for the construction of a low-gradient canal. With almost no deep cuts and few important fills, the 35-mile ditch carries the water across the flood plain and terraces to the power houses at a descending gradient of only three inches per mile. Since the gradient of the valley itself is from six to seven feet per mile, a considerable head is gained, about 144 feet in all, for utilization at the two power houses. The Genoa-Columbus location of the project is particularly propitious because it is possible to divert the reliable waters of the Loup onto the high and well-formed terraces of the inconstant Platte.

3. The fine texture of the surface material.

If the texture of the surface material along the route of the canal had been as coarse as it is in the river beds, a water-bearing earth canal along the north side of the Platte-Loup valley would have been an impossibility. Fortunately, this was not the case. After the formation of the Platte terraces, a thick layer of buff-colored "rock flour," the Peorian loess, was deposited by wind over the upland, the terraces, and the outer flood plain. This fine-textured loess, although not everywhere deep enough to protect the canal bottom, does serve to lessen the subsurface movement away from the canal, and it is certainly much more nearly impermeable than the alluvial sediments underlying it. In a few places, however, the seepage problem is still serious, and the power district engineers are now experimenting with bentonite, a pulverized clay material, in an attempt to solve the problem.

4. The availability of construction materials.

Construction of the Loup project was facilitated by the presence of a number of the required basic materials along the Platte and Loup valleys within easy hauling distance. Gravel, needed in thousands of tons, was pumped from the river banks, graded, and put in piles to be hauled away by motor trucks for use in surfacing roads and in preparing foundations for railway sidings, penstocks, and other steel structures. Sand, too, was required by the project in enormous quantities, mainly for making concrete. The numerous sand pits along the Loup River experienced a thriving business throughout the pe-

riod of construction. Cement, an important item in such a project, is not available along the Loup River, for there are no limestone outcrops. Such outcrops do occur, however, along the Platte River in eastern Nebraska, and with a haul of less than 100 miles from the cement plant at Louisville a high grade product was available at the site of the project. The availability of these three products, gravel, sand, and cement, is a factor of primary importance in determining the cost of hydroelectric development, for the freight costs in transporting such heavy materials multiply rapidly.

To obtain the right-of-way needed for the construction of the project, the Loup River Public Power District purchased about 3,750 acres of land, most of which was first grade crop land, producing excellent crops of corn, oats, wheat, and alfalfa. All of this agricultural land is now permanently removed from production. Only a small percentage of the land involved was wooded, as natural forest here occurs only along the inner edge of the flood plain. The largest area which had to be cleared of trees was about 110 acres of willow, cottonwood, and other varieties in the vicinity of the diversion structures. Much of the willow brush was used by the District in making riprap for protecting dikes and canal banks, while the larger trees were sold or given away for firewood. For building the transmission lines, the District had to secure suitable poles from the Douglas fir areas in the Pacific states.

Among the many new cultural features associated with the hydroelectric project are the two power houses, the canal, the diversion dam, a two-mile settling basin in which most of the river silt is deposited later to be pumped back into the old river channel, three inverted concrete siphons for carrying the canal water beneath the beds of muddy minor drainage lines, two similar siphons for carrying the canal water beneath railroads, 29 public bridges allowing federal, state, and county roads to cross the canal, 14 private farm bridges permitting farmers to reach newly-isolated fields across the canal, two railroad bridges, a pipe-line bridge, and several hundred miles of transmission lines.

Hydroelectric development in Nebraska is handicapped not only by physical conditions, such as a lack of "fall lines" and natural reservoirs, but by human, or cultural, conditions as well. The relative sparseness of the population (compared with eastern United States) and the distribution of a large percentage of the population in isolated family units on individual farms make necessary long transmission distances per unit of electrical market. Moreover, the relative unimportance of manufacturing in the cities of eastern Nebraska, with perhaps the exception of Omaha, tends to make the market for electrical power even in the urban centers quite limited. A factor in favor of water power development in this state, however, is the absence of the usual competitors, the mineral fuels. Coal, oil, and natural gas have not been found within the borders of Nebraska in commercially exploitable quantities.

Water power has been of much less relative importance in Nebraska than in the country as a whole up to the present time. During the nine years from 1923 to 1931 inclusive, of the total production of electricity for public use in the United States, about 35 per cent was produced by water power. During the same period in Nebraska only 7 per cent of the electricity generated was by means of water power. At the same time, in Nebraska, the total production of electricity increased by 88 per cent, while the production by water power increased only 61 per cent. Up to about 1932, hydroelectric power in this section of the country seemed to be dwindling in importance. The small rivers which were easily adapted to power development were already harnessed. To harness the large rivers and the smaller streams not so well adapted for development entailed enormous initial cost. Individuals, corporations, and municipalities dealing in electrical power hesitated so to

burden themselves with debt and built steam or Diesel plants. Kerosene lamps lighted the rural homes, and coal- and oil-burning generators furnished electricity to the urban centers, while most of the rivers, like the Loup in Nebraska, "flowed unvexed to the sea."

Now, with liberal government assistance, the Loup River Public Power District at Columbus, and its sister districts at North Platte and Hastings, will help transform the cultural landscape into a brighter and more pleasant picture than it has been in the past.

Need for Research on Grasslands

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Grasslands contain vast stores of unexplored knowledge, which will enrich the fields of plant and animal ecology, evolution, climatology, geography, and geology: such as, the evolution of grassland plants and animals, the influences of environments ranging from the tropical lowlands to deserts and alpine summits upon distribution and origin of species, the results of interrelations between plants and animals under widely varying environments, the linkage of present geographic distributions and characteristics of grassland species to forest, aquatic, and desert species and to earlier geological species and conditions.

Little effort has been made to use grasslands in their original condition. Aided by the "Westward Ho" movement, by the lack of a constructive land policy, by the expansion in power farm machinery, and the demand during the World War for more wheat there has been a scramble, at times a frenzy, to "break" the sod. This drive to settle the West and plow up the grassland did not stop until millions of acres were turned "wrong side up" and the dust clouds, blown from these lands, reached the Atlantic seaboard. Now, after a large part of our grasslands have been wasted, interest and appreciation are being shown in this natural resource. The immediate and insistent demand is to get the land back into grass. But to restore the grassland is no easy matter. Nature required thousands of years for this process. Grassland, as it existed before breaking and consequent erosion, was the result of countless interactions over a long period of time of plants, animals, and climatic and soil conditions. The best that can be done is to try to adjust human operations and relationships to nature's processes and requirements. Reseeding will aid in hastening the process of invasion. But much more is necessary. In man's struggle with the environments there are two alternatives: He must either change unfavorable factors so they will be more favorable to his well-being, or he must adjust himself to these factors. This law operates in man's relations with grasslands, which in many places have now gotten out of control due to mismanagement. Man made a serious mistake when he attempted to make all grassland more favorable to his well-being by plowing, by draining, by burning, by overgrazing, etc. He has learned that he must have much land restored to grassland in order to avoid greater evils. He may have learned that he must adjust himself to the needs and ways of grassland, if he is to survive in grassland country.

The following phases merit much additional research:

1. Study of life history and habits of individual grassland plants and animals.
2. Study of the processes of biotic communities, such as invasion, competition, association, and succession.
3. Study of the relation of

plants and animals to soil building, soil improvement, and soil binding.

4. Basis soil studies.

5. Study of the relation of vegetation and animal life to climatic conditions.

6. Study of the relation of animals to climatic conditions.

7. Study of inter-relation between vegetation and grazing by livestock and by wild animals.

8. Study of the inter-relations of vegetation and biotic factors.

The Occupance and Abandonment of Tye; A Cascade Mountain Community

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During the eighties and nineties several transcontinental railroads were seeking routes across the Cascades to tap Puget Sound ports. After numerous surveys the Great Northern Railroad finally selected Steven's Pass and the Skykomish Valley in western Washington as its most advantageous route through the Cascades.

The upper approaches to the west side of the pass were so steep that the first crossing consisted of a series of "switchbacks." Over these train sections of seven cars each were shuttled back and forth from one level to the next.

The small community of Tye had its inception in the work boom connected with the construction of the "switchbacks" and grew more permanent when train service was instituted over the new line in 1893. Tye became the place where crews for the helper engines were stationed for service on the "switchbacks," and also where track maintenance crews were quartered. The shacks, which housed about 70 permanent residents, fringed a small hanging cirque. Above the town was the steep divide country of the Cascades; below, the deep, sinuous Skykomish Valley extended in rugged relief.

Many examples of upper Cascade adjustments comprise the ecological pattern of Tye. Although this pattern is a resultant of several factors, the location of the town at high elevation far from any center of large population, the isolation resulting from climatic conditions, and the limited space are perhaps the most important.

During its existence Tye experienced three work booms, each of which attracted migratory workmen who worked in and out of the community during these periods. Brought into being by the construction of the "switchbacks," the town experienced its second boom in 1900 when these were abandoned and a three-mile tunnel bored through that part of the hill formerly ascended by the "switchbacks." Because steam cannot be used safely in long tunnels all traffic through the tunnel was handled by electric power, necessitating a change from steam to electric motors at the tunnel entrances. The third boom came with the construction of snow sheds over the track through areas of consistent snow slides. These protective sheds were constructed during the summer months, often employing 2000 men.

Tye before its abandonment was perhaps the only town in the world to have all sidewalks roofed over so that during the winter people could go about town with comparative ease through the resulting tunnels. With an average of twenty-seven feet of snow annually shoveling sidewalks would have been futile. The limited space for building and the necessity for covered sidewalks made this settlement very compact. Houses were crowded together, often joining one another wall to wall. In many instances buildings were erected on platforms extending over the tree stumps. In places of depressions, such as small stream gullies, pilings were

erected to support houses so that no space might be wasted. One or two small streams ran underneath several houses supported in this manner.

Confined to the town by the heavy snowfall, the people were forced into an unusually intimate village relationship. Everyone knew everyone else in town; all events great and small were practically communal property.

In 1925 the directors of the Great Northern Railroad authorized the construction of a new 8-mile tunnel nearly 1000 feet in elevation below the town of Tye. With the completion of this bore Tye was abandoned, business enterprises closed, and the railroad population scattered to new terminals.

A New Series of Crop and Livestock Annual Variability Maps of Nebraska

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The annual variability crop and livestock maps of Nebraska described in this paper form the beginning of a new series which show production by the median and percentile deviations from the median for as long a period as data are available instead of the mean or average conditions which are usually used. The ordinary crop and livestock maps usually show average conditions for a given period of time by use of dots, colors, or conventionalized symbols. Maps based upon percentile deviations both from the mean and median have been made to show climatic conditions by Earl E. Lackey and published in the Monthly Weather Review for March, 1935, and in the Geographical Review, January, 1936.

In making this series of crop and live stock maps, the use of productions calculated from the median for a given period of time was considered more desirable than corresponding percentiles calculated from means and standard deviations. Medians and percentile deviations calculated therefrom represent exactly what the data show, whereas percentile deviations calculated from means and standard deviations while they present a symmetrical picture, do not represent the data as accurately and are liable to misinterpretation.

For example, the median production of corn in Cuming County for 23 years was 38 bushels per acre. This signifies that the yield was less than 38 bushels 11 times and more than 38 bushels 11 times out of the 23 years. The average or mean production was 35.6 bushels per acre, 2.4 bushels below the median. The data also show that 15 times out of the 23 years the yield was higher than the mean and 8 times it was lower. In Nebraska, the mean or average corn yield was below the median in 63 counties, above the median in 27 counties and the same in 3. In the case of wheat, the mean was below the median in 55 counties, above in 33 counties and the same in 5 counties.

Maps based on actual yield for 20-, 40-, 50-, 60- and 80-per cent of the time were made for corn, wheat, cattle and swine. One who studies a 50 per cent corn production map ,seeing that a 30-bushel isotherm passes through Lancaster County, knows that the yield has been 30 or more bushels per acre 50 per cent of the time and that it has been 30 or less bushels 50 per cent of the time. If the mean had been used, it would not be known whether the yield had been very high enough times to make an average above the median, or if the yields had been quite uniform, making the mean about the same as the median, or if there were several years with very low yields which might have reduced the mean below the median. Similar interpretations are given for the other percentile maps.

This series of maps presents a summary of conditions that have prevailed in the past. To the extent that the record of the past may be used as a criterion in making forecasts, these annual variability maps may be used

to predict what may be expected in the future. Assuming that geographic conditions in any area are relatively constant, a farmer or investor, by scanning these maps, can make an intelligent estimate as to what he may expect different percentages of the time with respect to the yield of corn or wheat per acre. The same degree of predictability does not hold true relative to cattle and swine distribution because of the variable economic factors that affect their production. The investigator can, however, by studying these maps, determine which regions are likely to be best adapted to animal production.

Some additional values and uses of these maps include studies to show the relation of the yield of a crop to soil regions; studies to indicate effects of climate and weather condition upon yields; studies to show the distribution of livestock in relation to grain, pasturage and hay crops; and possibly studies to indicate changes which occur in density of production of livestock with respect to economic conditions.

In order to make the maps more meaningful and to know the reliability of them, the data may be used in working out the probable error of the medians. For example, using corn in Fillmore County, the P. E. (Probable Error) of median is 1.8 bushels, which interpreted means that the chances are even (50-50) that the yield will be within 1.8 bushels of the median (25 bushels) or between 23.2 and 26.8 bushels per acre. The P. E is 0.9 bushels for wheat in Fillmore, which means that the chances are even (50-50) that the yield will be within 0.9 of a bushel of the median (16.4 bushels) or between 15.5 and 17.3 bushels per acre.

Limitations in studies of this kind include the short period of time that records have been kept; errors in obtaining data; and in some cases faulty estimation of yields.

The Physiographic Expression of the Indian Creek Plutons of the Denver Mountain Parks Region, Colorado

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The physiographic pattern of the Denver Mountain Parks area, fifteen to twenty miles west of Denver, Colorado, is developed over schist and ranks of granite plutons in *en echelon* pattern having striking structural and topographic trends from northwest to southeast.

The granite plutons stand out as lumpy granite mountains which have oversteepened southeast faces and long smooth heavily timbered northwest slopes. Granite dikes form low ridges and festoons of little elevations which link the plutons and emphasize the northwest to southwest topographic lines. The schist into which the granite is intruded is a relatively weak rock and underlies the valleys and the flattish "parks" common to the area. The entire upland of the Denver Mountain Parks region lies seven to eight thousand feet above sea level.

Major streams are antecedent to the present topography and are adjusted around the granite plutons and mostly flow eastward through canyons five hundred to a thousand feet deep debouching from the mountain areas into the foothills region at about six thousand feet a. t. Subsequent and consequent tributaries have a trellised pattern such as is developed in folded beds of sedimentary rock, but here the bedrock is alternating weak beds of schist and strings of strong granite dikes and elongate plutons, with well developed northwest to southeast trends.

The geomorphology of schist and granite has influenced settlement patterns. Mountain ranches which produce oats and potatoes, lettuce and

peas and wild hay occupy the heads of subparallel valleys in the schist. Summer homes of Denver people and tourist cottages fill the "parks" and are concentrated on the southwest sides of granite mountains and ridges. North and northeast facing slopes are mostly timbered and lumber mills are numerous in the heads of the northwest facing valleys.

The Structure of Summer Wind Over San Juan Island, Washington

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This paper is the result of the first of a series of experiments being conducted at the University of Washington Oceanographic Laboratories, Friday Harbor, San Juan Island, upon the problem of summer wind structure over San Juan Island, under the direction of Dr. Phil E. Church.

Data for the experiment was obtained twice daily by pilot balloon observations. A reduction of the data taken gave a picture of the vertical structure of the air over San Juan Island to an altitude of four or five kilometers. The reduced data included wind velocity and direction. From a study of forty flights plotted on velocity-direction graphs of the Weather Bureau, a cross-sectional analysis of the winds present was made.

Two general types of wind were found to exist. These were the gradient and the non-gradient winds. Of the non-gradient winds there are several sub-classifications: The Local Surface Sea Breeze, the outer edge of the Mainland Sea Breeze and other types which have not been classified as yet. In this analysis a gradient wind was considered to be one whose direction graph showed a turning of less than 90° in its entire vertical structure. There was a barometric gradient which determined the velocity and direction of the wind. The average direction of the gradient wind was found to be ill-defined, and its velocity was slow for the twenty days on which it was found to be blowing.

The non-gradient wind was considered as one which showed a directional turning of *more* than 90° through the vertical. Therefore this general type of wind is the result of a *thermal gradient* set up between the warm land masses and the colder water surrounding them, which in turn cause local differences in pressure. Eighty per cent of the non-gradient winds occurred during the afternoon hours when thermal differences were at a premium.

The Local Surface Sea Breeze is a result of the difference in heating between San Juan Island itself and the surrounding water. Two excellent examples of this breeze were noted. One, on July 19, attained a thickness of five hundred feet and one on August 5, one thousand feet. The velocities of these winds were slow for both flights.

The outer Edge of the Mainland Sea Breeze is the result of a difference in heating between the mainland of Washington State to the east some thirty miles, and the waters of Washington Sound, the Strait of Georgia and the Strait of Juan de Fuca. Due to the distance of San Juan Island from the mainland, this breeze was found at high elevations as a thin layer of air moving down the local barometric slope caused by heating of the mainland.

There were some flights which showed winds of so complex a nature that as yet no attempt has been made to classify them. They may have been due to a combination of the other causes. They will be taken up in a later paper when a more complete set of data, covering a longer period of investigation, have been accumulated.

A Cooperative Method of Mapping Land Utilization

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The mapping of land utilization as a school project is a relatively new development in the field of geography and during the last decade has made considerable progress in the field of education.

Wayne County, Nebraska, is well adapted for a project of mapping land utilization. It is located in the northeastern part of Nebraska and has an area of 450 square miles. It is near the center of the Loess Hill Area where the land is gently rolling but not too rough to interfere greatly with general farming. The county contains eighty-five school districts, which serve well as units for the project as they are all about the same area. There are roads on practically every section line regardless of topography, thereby setting off each section as a definite unit. Every section of the county is used for general farming and no section has less than fifty per cent of the land under cultivation. The type of agriculture of the county is characteristic of the corn-belt. Corn is the main crop and it occupies about fifty per cent of the cultivated area. Corn is followed in acreage by oats and alfalfa. The distribution of crops is much the same throughout the county and the legend suitable for one part is also suitable in all other parts.

Local preliminary surveys of land utilization were carried out by two classes of college freshmen. Each member of the two classes was required to map one section of land within the county. The two classes were given different classifications for land uses in order that the two systems could be tested in the field and the results compared. From these preliminary surveys the crop legends were chosen for the project in the rural schools of the county.

Each of the eighty-five schools of the county received the following:

1. Outline map of their respective school district drawn to the scale of four inches to the mile.
2. One dozen mimeographed section maps for pupils' use.
3. An ideal section map complete with the primary and secondary symbols added.
4. A box of pencil colors for the map work.
5. A letter of instructions for the development of the survey of the district.

The plan of mapping was explained to the rural school teachers at their annual county teachers' institute. The plan presented to the teachers involved six important steps, namely:

1. That each pupil was to fill in the outline map of his home section where possible.
2. If it happened that there were sections in the school district which were not represented among the pupils, these sections were to be assigned to those who were most interested and capable of doing the mapping.
3. If there were enough pupils, several could be assigned the same sections to map and then comparisons made as to accuracy.
4. Pupils of the seventh and eighth grades were to do the field maping, unless their numbers were insufficient, then sixth grade pupils might help.
5. The teacher was to map the area near the school with the class for the purpose of group instruction.
6. When the pupils had completed their section maps, the teacher was asked to transfer the data to the large map of the district.

The first completed map was returned in three weeks and at the end of two months, 42 district maps were received. In all, fifty-four completed maps were received by the director of the survey.

The mapping project received much favorable comment from the people of the districts and those who helped the youngsters in the mapping ex-

pressed many comments of praise. Favorable letters were received from a number of teachers. Several teachers said that due to the interest shown by the pupils in developing the survey, they had made further studies of their districts.

The limitations of the project on the mapping of Wayne County or perhaps one may say any county project of this type, are quite large in number. Among them the following may be listed:

1. The project being voluntary with the schools, the director could not hope to get all of the school districts to cooperate in the mapping.
2. The teachers in a few of the districts were incompetent to direct the pupils in the collection of the necessary data for the survey and others were indifferent.
3. Some of the teachers looked upon the survey as too much work or saw little or no value in it.
4. The critical attitude of farmers in a few districts made it impossible for the pupils to collect the necessary data.
5. Some of the schools had too few pupils to attempt the mapping of the district and in others, the pupils were too young to carry out the survey.

Annual Variability Rainfall Maps of the Great Plains

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In any field of research the worker must be certain that his tools are adapted to the requirements of his problem. This is especially important in the field of geography where the researcher so frequently dpends on tools constructed for use in other fields of study. This paper deals with measures of central tendency and of percentile variability calculated from over 500 weather stations as applied to the making of rainfall maps of the Great Plains. Vertical bar graphs showing these measures for selected stations on the Great Plains are presented. One of the maps shows central tendency (50 per cent map) by use of the median annual rainfall for each of the stations of the region, and four maps indicating condition of annual variability—20, 40, 60 and 80 per cent of the time, respectively.

Note: Maps, graps, and discussion will appear in an early issue of The Geographical Review.

Note—Maps, graphs, and discussion appeared in the October, 1937, issue of the Geographical Review, Vol. 27, page 665.

The Urban Pattern of Denver, Colorado

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A map of the urban pattern of Denver was prepared by the class in Human Geography at the University of Denver during the Winter Quarter of 1937. Each member of the class was assigned a section of the city for survey and mapping in color on a regular base map. Types of houses, commercial interests, business centers, churches, educational institutions, parks, playgrounds, etc., were investigated and plotted. The parts were assembled and the map, mostly uncorrected, was presented.

A brief summary of the historical background of the city was related to the growth of its parts. Present tendencies in expansion and topographic advantages and limitations were noted. Future expansion and its origins were forecast.

The Sponge Industry of the Caribbean Area

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Within the span existing between the time of shipping the first trial lot of sponges to Paris from Nassau, in 1841, to the present, lies the entire history of the sponge industry in the Western Hemisphere.

The two chief areas of production in the western world outside the United States are the Bahama Islands and Cuba. In 1935 these regions contributed 66 per cent of the weight and 43 per cent of the value of sponges of the Western Hemisphere.

The Bahama fishery accounts for 22 per cent of the value and 33 per cent of the weight of all the Caribbean. The industry centers around Andros Island—an exposed area, known as "The Mud," where the velvet type predominates; Little Bahama Bank, where the wool type comprises 95 per cent of the catch, and the territory west of Elenthera Island, which produces both wool and velvet varieties.

Sponge cultivation recently attempted in the Bahamas, has proved successful. The greatest difficulty is the attack made on young sponges by starfish and a certain type of crab. The hooking method, employing 12 per cent of the population of the islands, is the only one used. The catch yields about $200,000, which makes it the island's most important industry.

The south shore beds between Cuba and the Isle of Pines yield practically all of the Cuban sponges. Water depths are ideal for hooking, the only method employed. About 1700 fishermen engage directly in the industry but 5,000 persons derive a living from the business as a whole. The smallest catch comes during the hurricane season. Cuba outstripped all other countries in 1935 in production of sponges. Operations radiate from Botabano. All shipments are made from Havana. A recently formed cooperative does much to improve and enhance the industry. Yearly production amounts to about $455,000. United States, Germany, and France take 75 per cent of Cuba's export. Sponge waste, sold in the United States as an insulator, adds some $1500.00 to the yearly income.

British Honduras began a governmental sponge industry in 1936, off Turneffe. Cuttings, supplied to individuals, encourage the industry. This represents an investment of some $18,000. The yield is gradually increasing. About 300,000 sponges grow on the concessions.

Mexico, Nicaragua, and Colombia are other Caribbean countries where the industry has not had benefit of proper supervision and control.

With the interest taken in the sponge industry in the Bahamas, Cuba and British Honduras, the Caribbean seems destined to hold the position it now has in the sponge world, as the chief producer of the Western Hemisphere.

Vocabulary of High School Physical Geography

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Geography teachers frequently discover students who have a very small or practically no geographical vocabulary. This is a condition that should be remedied as much as possible by definite study and drill upon important geographical expressions.

If a teacher has an alphabetized list of geographical words, terms or phrases for each chapter of a textbook, and a master list for the entire book, it is then possible to have copies of the list made by chapters and given out to students in the class or classes where the book is being used. The teacher then not only can use the words in their relationship to subject matter, but pre-tests may be given in the classes before the book is studied and then later final tests at the end of the semester may be given to determine what has been achieved in the use of geographic words.

In this vocabulary study, the book, *"New Physical Geography,"* by Tarr and Von Engeln, published by *The Macmillan Company,* was selected and used. The textbook was read through carefully, then each geographical word, term or phrase was underlined with a red pencil. A file was secured one foot long and four inches wide with cards to fit. Each geographical expression in chapter one was typed upon a card together with the chapter and the page numbers. The cards were then filed in alphabetical order, with like words, terms and phrases together; so that all could be counted and tabulated. This same procedure was carried on by chapters throughout the entire book. The expressions were then taken out of their alphabetical order and listed according to their frequency of usage. In adding all of these different expressions together upon a master sheet it was discovered that the book contained a geographical vocabulary of 1,081, with a total of 16,051 times that these expressions were used.

The total list of 1,081 words, terms or phrases probably is not complete, because no list secured from frequency counts can be without error. It is certain that in a frequency count some important words secure higher frequencies than some important words.

It is understood of course that a word list of this sort is not to be used to the exclusion of other means in the teaching of geography. Maps, graphs, pictures are some other possible ways in creating interest. Among still other means tests may be devised; such as, true-false, multiple choice, recall, matching, and identification tests to cover an understanding of the geographical expressions of the lists. It is contended that a vocabulary for a geography textbook should be a real time saver for teachers and readers.

Some Contributions of William Morris Davis to Geography in America

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When William Morris Davis accepted his first position at Harvard he possessed some training in many sciences, but was not a specialist in any field. Inasmuch as he was required to give instruction in geology and meteorology he was forced to develop his own methods. His methods and materials in the following years came into general use throughout the country.

Davis' works in the fields of geology and physiography have become known in every inhabited continent on the globe, but many of his less spectacular, though equally valuable, cotributions are often unappreciated even in his own country. Davis was the pioneer in school and college work in meteorology. His teachings and writings were probably the most potent force in establishing instruction in some seven thousands of public schools and nearly three hundred colleges and universities.

The report of the notable Committee of Ten of the National Educational Association in 1892 embodied many recommendations which Davis had made earlier in lectures before educational associations, and in various articles written for educational journals. These were concerned largely with the improvement of methods of teaching geography and with the introduction and expansion of physical geography in the high schools and the provisions for the continuity of geography from the primary grades through the university.

Papers in which Davis outlined in detail his definition of the science of geography and his classification of geographic factors are evidence that his philosophy of the subject included both physical and biological factors. However, he was so busy developing the physiographic phases that he was often accused of ignoring the ontographic, or organic, phases.

Davis always emphasized the value of a precise terminology and accordingly, tested, and through scientific journals, disseminated scores of technical terms which have become some of the most effective tools in geographical literature.

Present-day students who glibly discuss intrenched meanders, mature topography, peneplains, monadnocks, and river piracy should be interested in examining the wealth of literature in which Davis first presented and defended these and innumerable other terms.

Davis' integrity of intellect which is so clearly revealed in all his scientific writings carried over into his religion. These were epitomized in his Hector Maiben lecture before the A. A. A. S. in Boston only a few weeks before his death.

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